**Elliott Energy Systems, Inc.**
**2901 S.E. Monroe Street**
**Stuart, FL 34997**
**772-219-9449**
**www.tapower.com**

***Rick Lucas – Sales Engineer***

**January 17, 2003**

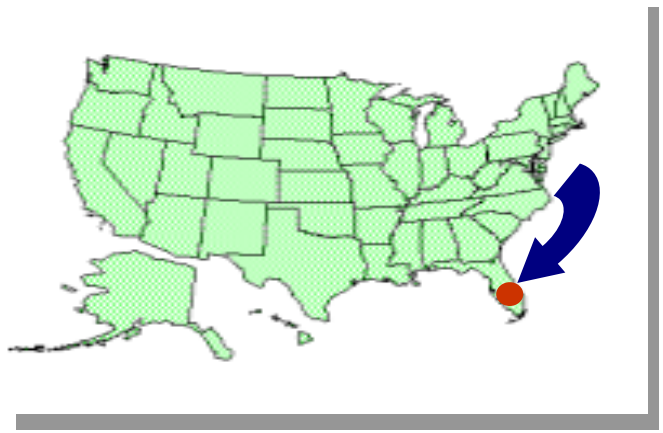
ELLIOTT ENERGY SYSTEMS
EBARA GROUP

## Contents:

- Elliott Energy Systems Background
- Elliott Microturbine Features
- Power Generation Products
- Cogeneration Products
- Elliott Microturbine Experience

# Elliott Energy Systems, Inc.

| | |
|---|---|
| **Established:** | **1996** |
| **Headquarters:** | **Stuart, Florida** |
| **Employees:** | **115 (as of December 2002)** |
| **Production Area:** | **42,000 sq.ft.** |
| **Main Product:** | **Turbo Alternator™ Microturbine** |
| **Capacity:** | **1,000 to 1,500 engines / year** |

# Elliott Energy Systems is Wholly Owned by Ebara Corporation

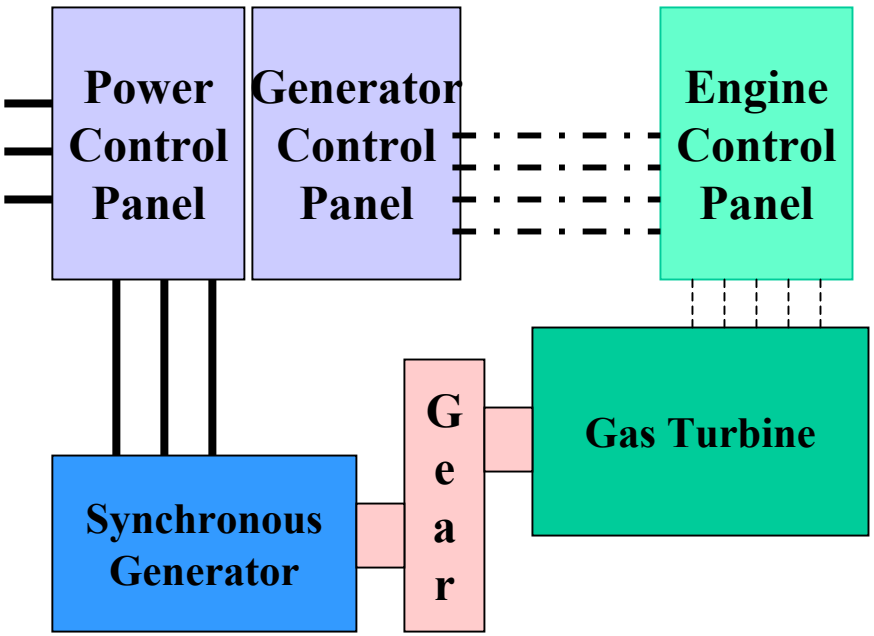
| | | |
|---|---|---|
| **Head Office:** | **Tokyo, Japan** | |
| **Founded:** | **November 1912** | |
| **Employees:** | **15,734** | |
| **Groups:** | **Fluid Machinery & Systems Group** | **37%** |
| | **Environmental Engineering Group** | **52%** |
| | **Precision Machinery Group** | **11%** |
| | **New and Renewable Energy Group** | **----** |
| **Shareholders:** | **33,473** | |
| **Stock Market:** | **Tokyo Stock Exchange** | |
| **Net Sales (2002):** | **$ 4.22 billion** | |

# Elliott Energy Systems

## Turbo Alternator™ Technology

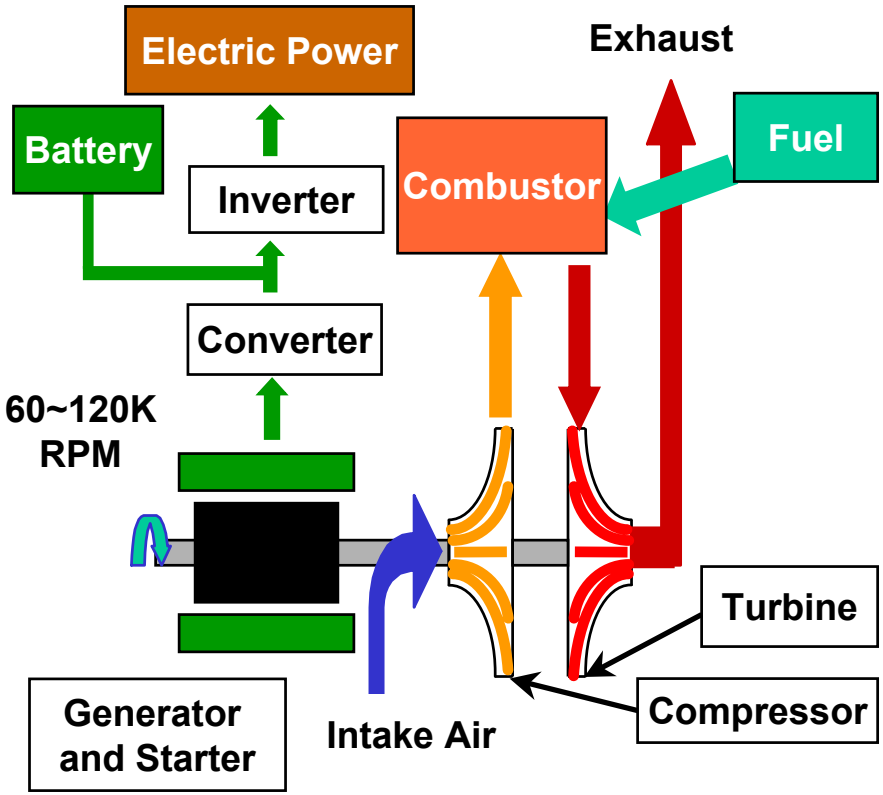
# Gas Turbine vs. Microturbine

## Conventional Gas Turbine Generator Set Arrangement




**Conventional Gas Turbine Size:**
**1 MW to 175 MW**

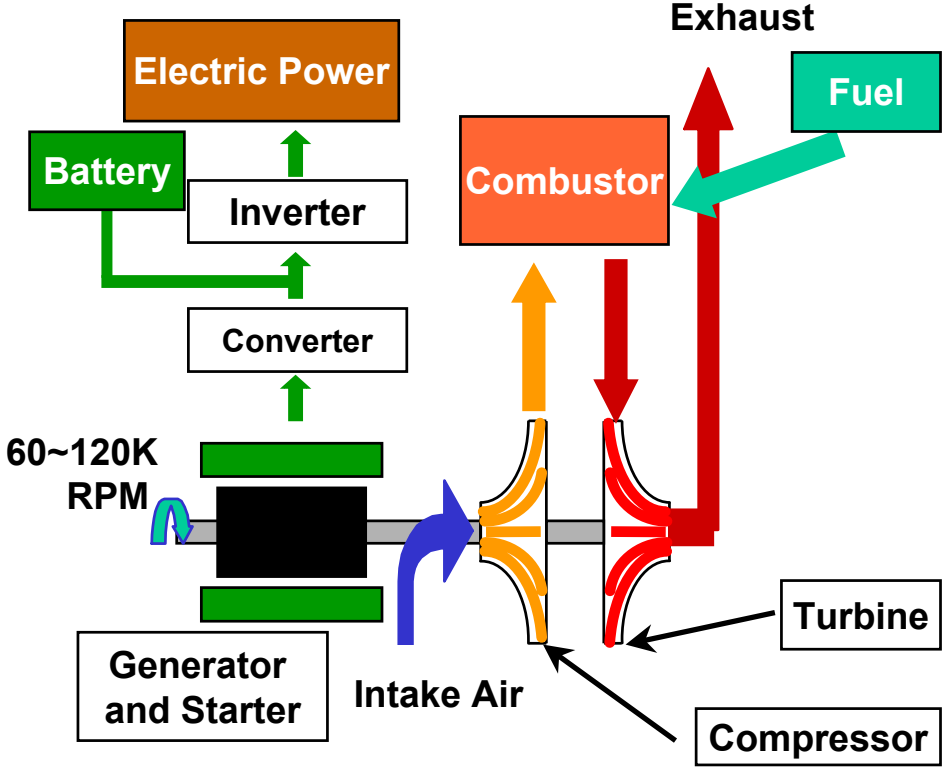
## Microturbine Generation Arrangement



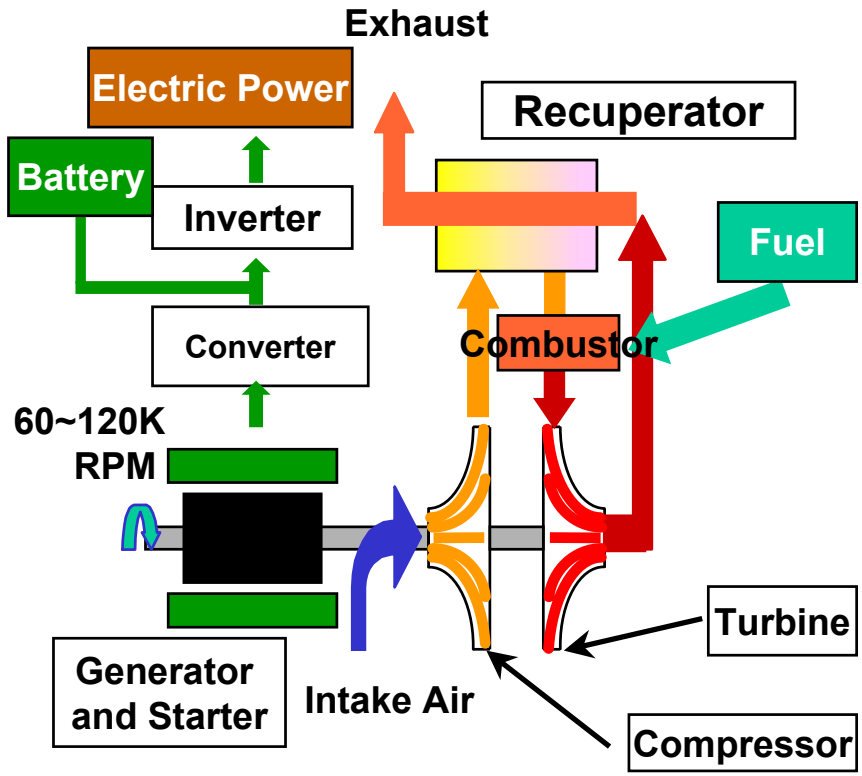

**Microturbine Size:**
**30 kW to 250 kW**

# Simple Cycle vs. Recuperated Cycle

## Simple Cycle



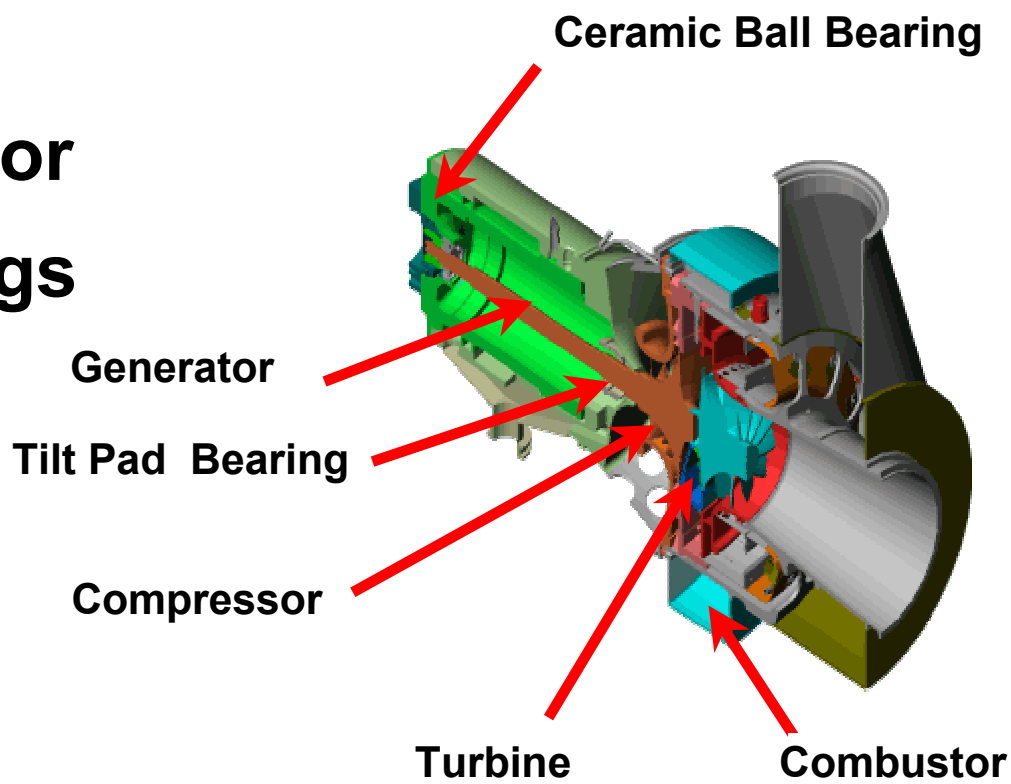

## Recuperated Cycle




**Recuperator Doubles Efficiency**

# Microturbine Components

- Radial Wheel Compressor and Turbine
- One-Piece Rotor Construction
- High-Speed Alternator Rotor
- No Gearbox
- Oil Cooled Stator
- Oil Film Bearings
- Electric Driven Accessories



# Power Electronics Technology

- Starting Capability Using 24 VDC or Grid Connection
- High Frequency Currency Rectified to DC
- DC Inverted to 50/60 Hz Currency Frequency
- Digitally Controlled Inverter Technology Provides Cleaner and Higher Quality Electricity
- Software Matches - Voltage / Current / Frequency
  - Frequency 50/60 Hz
  - Voltage 400/480 VAC
- Adjustable Power Factor

# Elliott Energy Systems Product Offerings

# Business Scope and Product Lines

## Business Scope

- Microturbine and Cogeneration Packages Sold to Qualified Distributors
- Microturbine Engines Directly Sold to End Users and Integrators

## Product Line

### Current

| | |
|---|---|
| TA 100 | Simple Cycle & Elliott-designed Recuperated with Natural Gas, Propane, Liquid Fuel or Low Btu Gas |

### Future

| | |
|---|---|
| TA 60 | Simple Cycle, Recuperated, Natural Gas, Propane, Liquid Fuel or Low Btu Gas |
| TA 300/400 | Simple Cycle, Recuperated, Natural Gas, Propane, Liquid Fuel or Low Btu Gas |

# Product Features

- **Efficiency (Recuperated)**
  - Current: 30 ± 2%
  - Near Term: 34 ± 1%
- **Multiple Fuels**
  - Gaseous — Natural Gas (CNG), Propane, Low Btu
  - Liquid — Kerosene, Jet A, No. 2 Diesel
- **Exhaust Gas Emission**
  - Natural Gas — Current $NO_x$ : < 25 ppm (15% O2)
  - Kerosene — Current $NO_x$ : < 50 ppm (15% O2)
- **Noise**
  - Standard Enclosure — 70 dBA @ 1m
- **Operation Mode**
  - Grid Tie, Island Mode, Parallel Up to 10 Units
  - Remote Monitoring and Control
- **Cleaner Power Output**
  - Microprocessor and Inverter Technology
  - THD: < 3%

# Regulatory Compliance

- **Elliott Energy Systems is ISO 9001:2000 Certified**
- **TA 100 CHP Commercial Unit Will Comply With:**
  - **IEEE Std. 929 – Utility Interface**
  - **IEEE Std. 510 – Power Inverters**
  - **IEEE P1547 – Distributed Power Interconnection**
  - **UL 1741 – Inverters**
  - **UL 2200 – Generator Assembly**
  - **NFPA 37 – Gas Turbines**

# EES Microturbine Advantages

- **Secure, Reliable Power**
  - On-Grid or Up to 1 MW of Off-Grid Power
- **Less Down Time**
  - Minimal Annual Maintenance
  - No Oil Changes
- **Direct, Clean Heat**
  - 150 kW of Thermal Power
  - 75% Cycle Efficiency
- **Lower Site Emissions**
  - $NO_x$ less than 25 ppmv
- **Power Quality Improvements**
  - Adjustable Power Factor (0.8 to 1.0)
- **Soft Start Capability**
  - Avoid Costly Variable Frequency Drives

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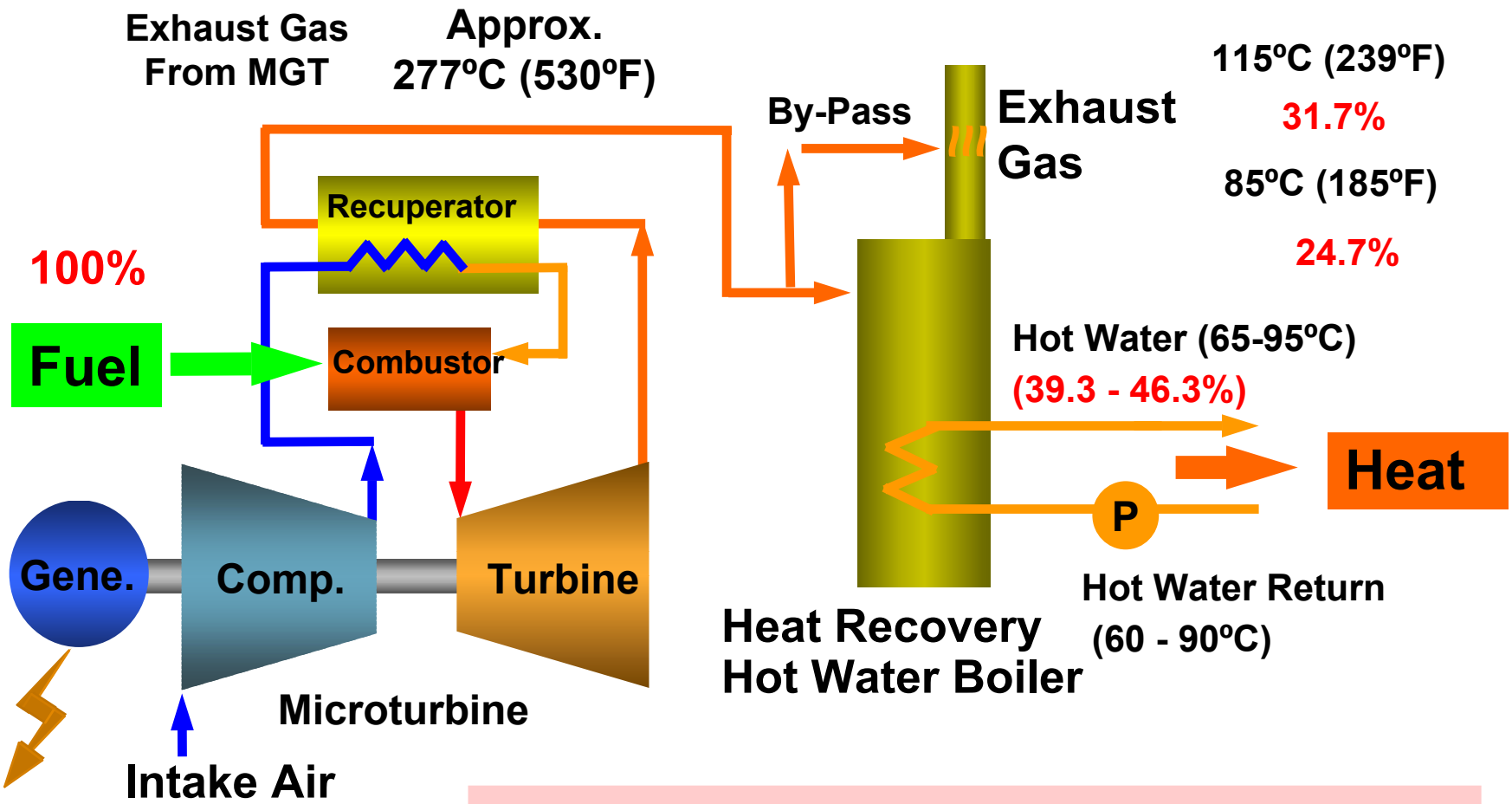
# Microturbine Development

**Extensive Testing - Over 200,000 Hours**

# Microturbine – Based Cogeneration Systems

# Hot Water Cogeneration (CHP) System

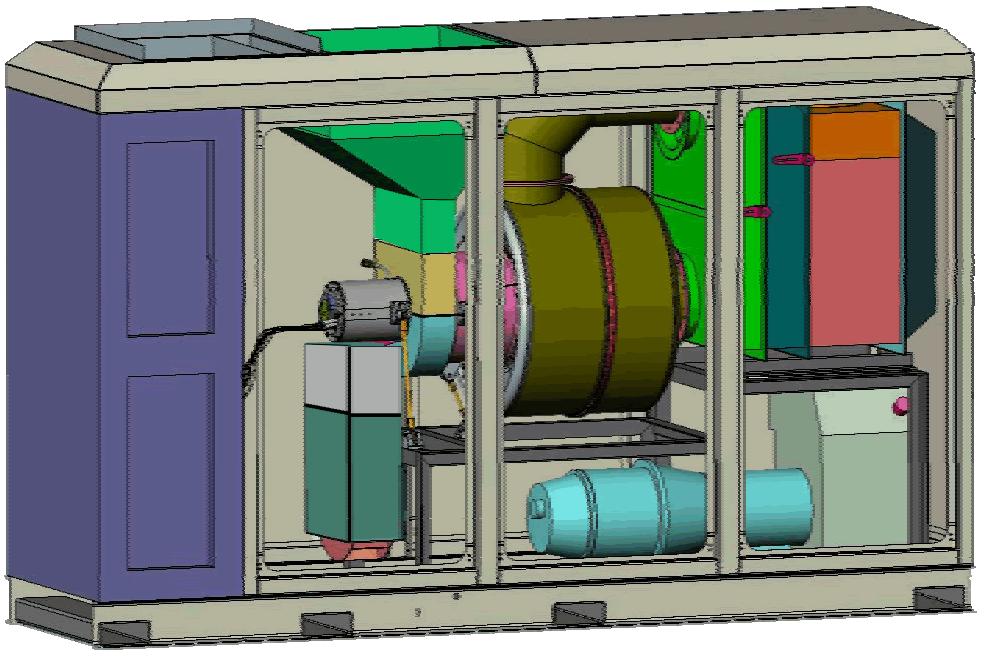
**Exhaust Heat → Hot Water (Area Heating, Process Demand)**




**Elect. Power = 30%**

**Total System Thermal Efficiency = 70 - 76%**

# TA100 Integrated CHP Package



**Dimensions:**

- **Height: 78 in.**
- **Width: 35 in.**
- **Length: 120 in.**

**Weight: 4100 lbs**

**Power Output (net): 100 kW (ISO)**

**Thermal Output: 130 - 150 kW**

- **Exhaust Temperature: 530F (ISO)**
- **Exhaust Flow: 1.82 lbs / sec (ISO)**
- **Fuel Flow: 0.014 lbs / sec**

**Exhaust Emissions (CNG)**

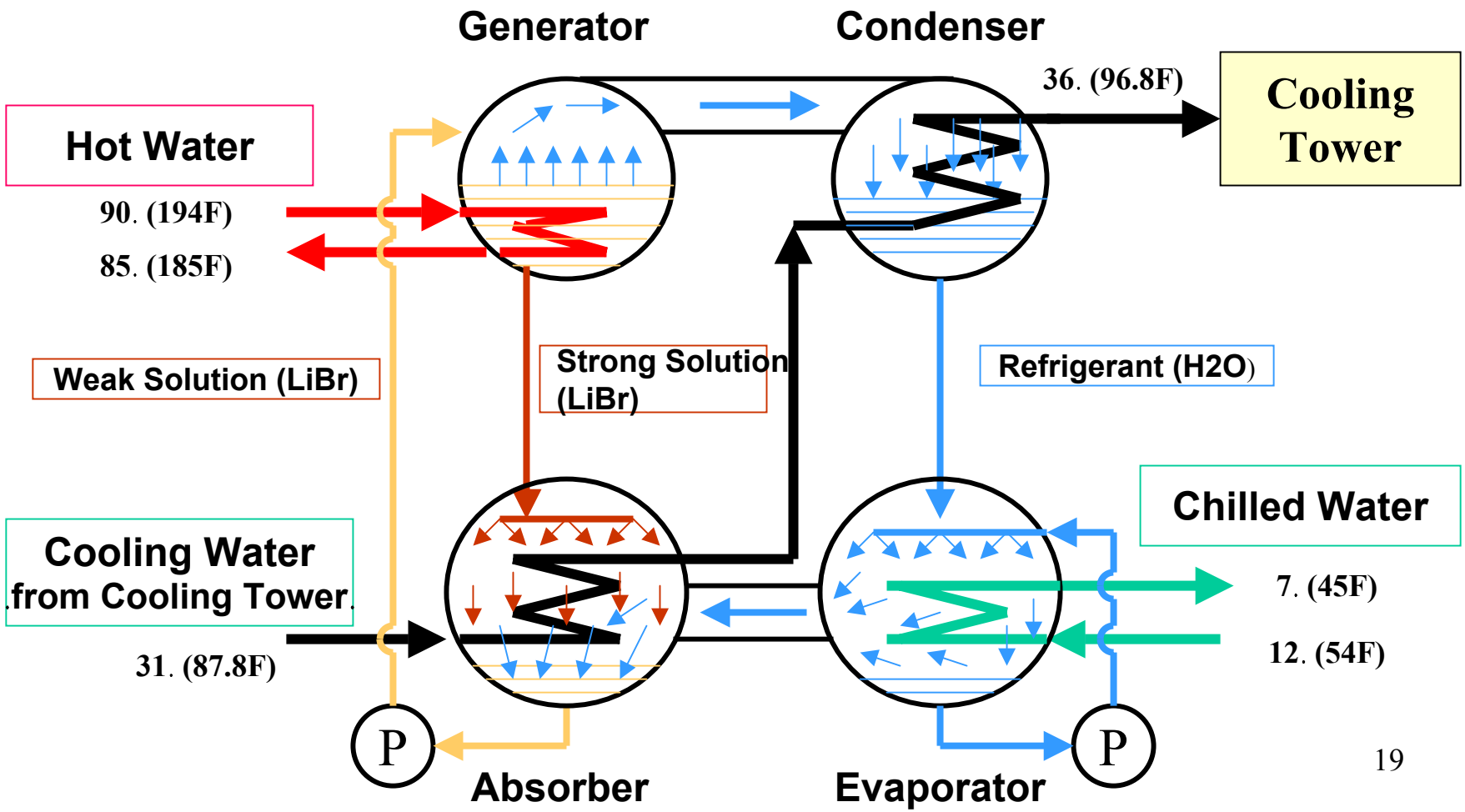
- **CO: < 30 ppmv**
- **NOx:< 25 ppmv**

**Enclosure: NEMA 3R (Weatherproof)**

**Available : April 2003**

# Theory of Absorption Chiller

## How Hot Water Can Produce Chilled Water…



# Ebara Direct-Fired Absorption Chiller

## Assembled Unit

## Side View

## Front View

**Ebara Has Over 50 years of Chiller Experience**

# Elliott Microturbine Experiences

# Applications

- Microturbines
  - Power Generation
    - Simple Cycle
    - Recuperated
  - Cogeneration
    - Hot Water
    - Steam
    - Hot-water fired Absorption Chiller
    - Direct-Fired Absorption Chiller
  - Tri-Generation (Power, Chilled Water and Hot Water)
- Future
  - Hybrid Systems: Fuel Cell

# Typical Installations

- Hotels
- Hospital / Nursing / Extended Care
- Sports Complex
- Colleges / Schools / Education Facilities
- Food Services / Food Processes
- Small to Medium Industrial / Factory
- Greenhouses
- Landfills / Bio Gas / Low Btu
- Offshore / Flare Gas

# Cogeneration Package - Sports Center

## Roof Top Installation

# Cogeneration for Metal Industry

## Galvanic Plant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# Cogeneration for Greenhouse

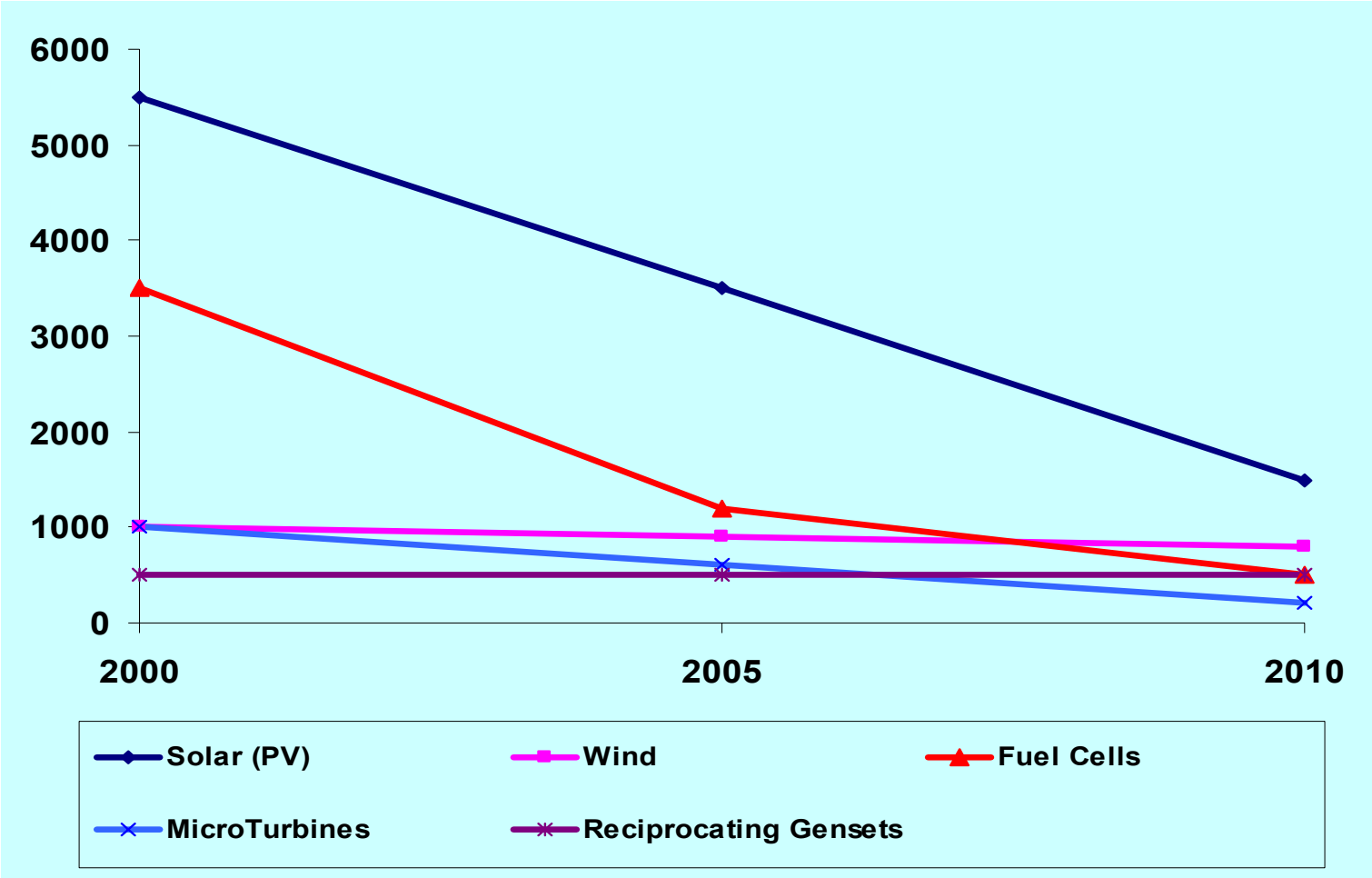
# Parallel Units Installation


**Five Units In Parallel Operation**

# Affordability

"A microturbine - based energy solution can save $$$"

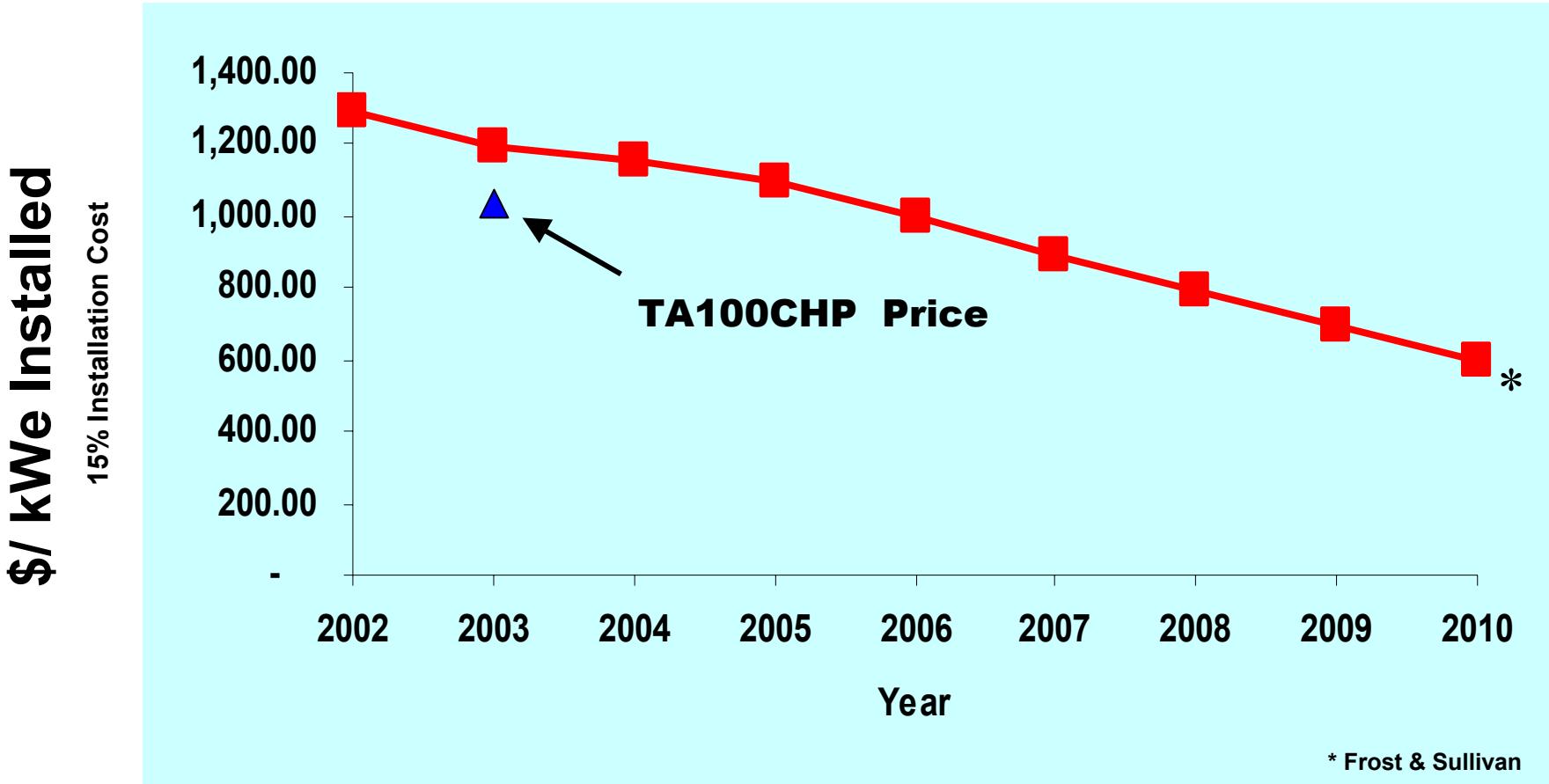
# Alternate Power Installed Costs per kW




* Frost & Sullivan

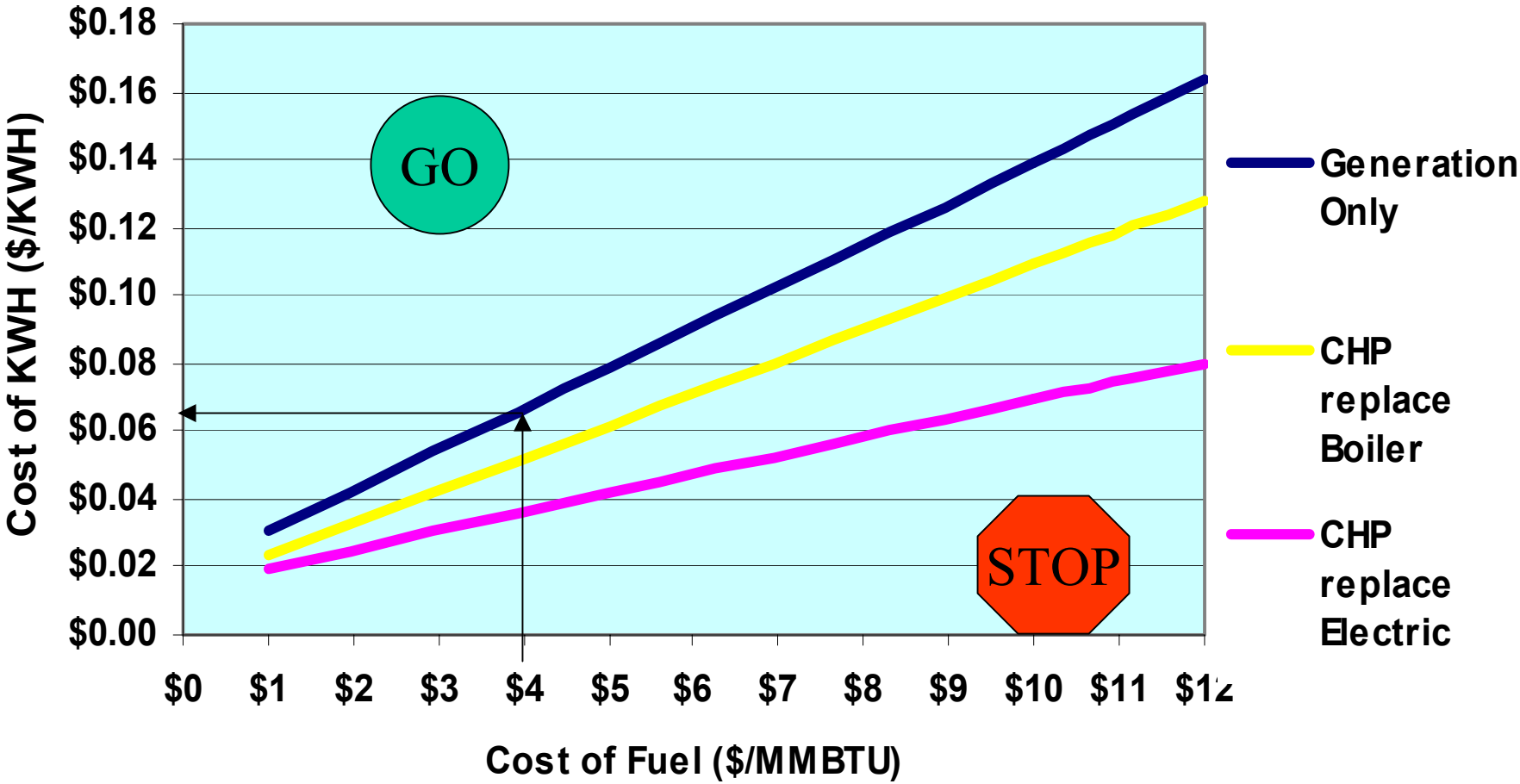
Microturbines are Competitive Today

# Microturbine Installed Costs

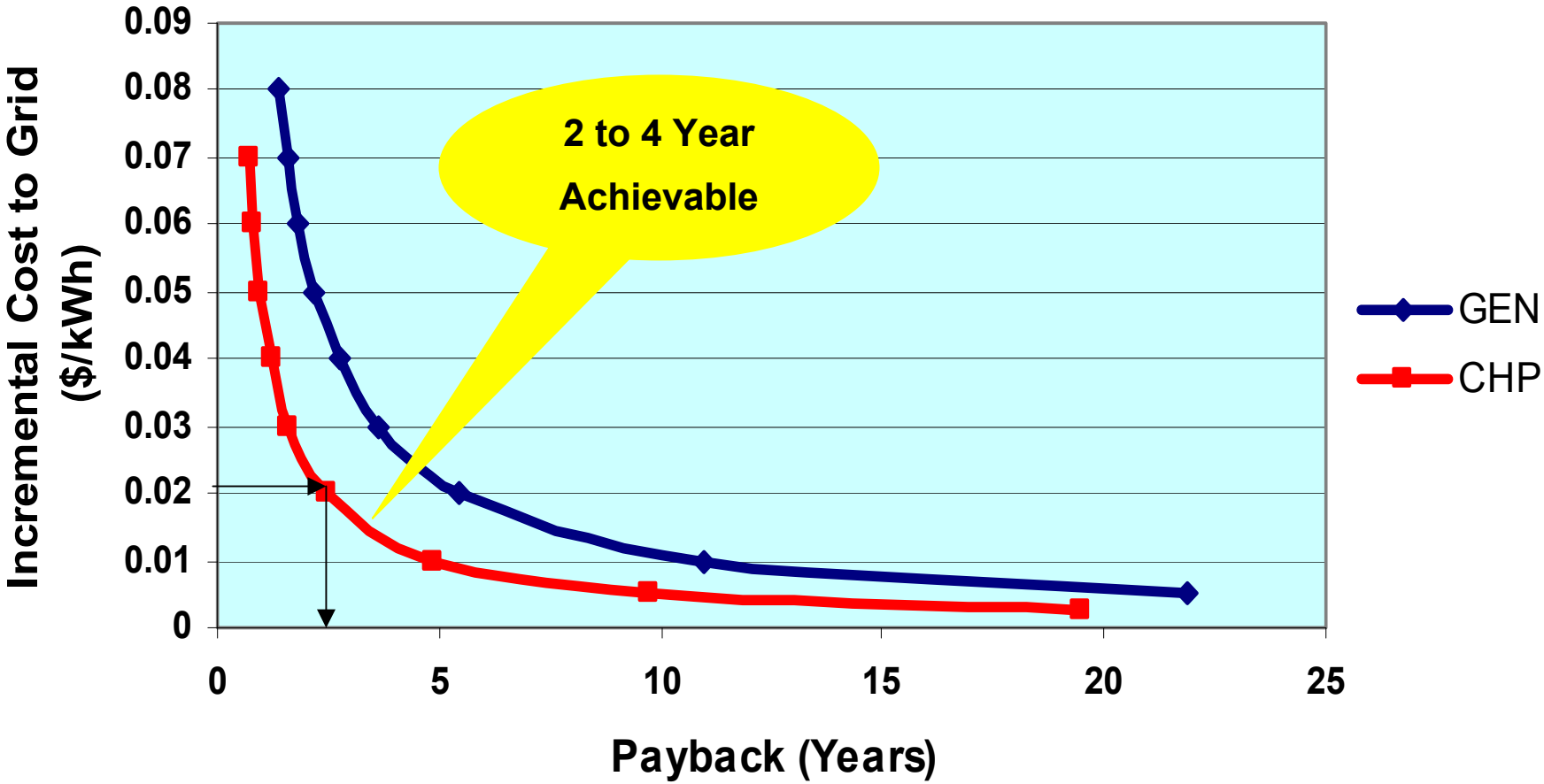



**EESI Offers a Competitive Product**

# Microturbine CHP Life Cycle Costs



# Microturbine Payback



# Summary

- Microturbine technology is maturing – reliability and life cycle costs not proven but look promising
- Early adopters will continue to be market niche applications
- Microturbines with CHP are economically viable and environmentally sound
- Elliott Energy Systems has product plan that satisfies the market needs